

# CURRICULUM VITAE

## Dr. Alexey Fedorov

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### POSITIONS

- 2018 – present     **ETH Zürich** (D-MAVT), Switzerland  
Senior Scientist, Laboratory of Energy Science and Engineering  
Laboratory of Prof. Christoph R. Müller
- 2014 – 2017       **ETH Zürich** (D-CHAB), Switzerland  
Oberassistent with Prof. Christophe Copéret

### EDUCATION AND TRAINING

- 2012 – 2013       **ETH Zürich**, Switzerland  
Post-Doctoral Fellow with Prof. Christophe Copéret, Laboratory of Inorganic Chemistry
- 2010 – 2012       **California Institute of Technology**, Pasadena, CA, USA  
Post-Doctoral Fellow with Prof. Robert H. Grubbs
- 2005 – 2010       **ETH Zürich**, Switzerland  
Ph.D. with Prof. Peter Chen, Laboratory of Organic Chemistry
- 2000 – 2005       **St. Petersburg State University**, Russia  
Diploma in Chemistry

### FELLOWSHIPS AND AWARDS

- Holcim Stiftung fellowship (2013, 2015)  
BP MC<sup>2</sup> initiative post-doctoral fellowship (2011)  
Swiss National Science Foundation prospective researcher post-doctoral fellowship (2009)

### TEACHING AT ETH ZÜRICH

- 2017 – 2018       529-0222-00L Organic Chemistry II (20%, with Prof. Jeffrey W. Bode)  
2014 – 2018       529-1121-00L Inorganic Chemistry for Biologists (50%, with Prof. Antonio Mezzetti)

### RESEARCH INTERESTS

Catalysis research, synthesis and characterization of well-defined model catalysts, structure-activity studies, 2D materials for heterogeneous catalysis, reaction discovery.

## PUBLICATIONS

Author Identifiers: [Scopus](#), [ORCID](#), [Researcher ID](#), [Google Scholar](#)

94. E. Kountoupi, A. J. Barrios, Z. Chen, C. R. Müller, V. V. Ordonsky\*, A. Comas-Vives\*, [A. Fedorov\\*](#), The Impact of Oxygen Surface Coverage and Carbide Carbon on the Activity and Selectivity of Two-Dimensional Molybdenum Carbide (2D-Mo<sub>2</sub>C) in Fischer-Tropsch Synthesis, *ACS Catal.* **2024**, *14*, 1834–1845.
93. Z. Chen, A. I. Serykh, A. Kierzkowska, D. Gajan, S. R. Docherty, A. Yakimov, P. M. Abdala, C. Copéret, P. Florian, [A. Fedorov\\*](#), C. R. Müller\*, Reversible Transformation of Sub-nanometer Ga-based Clusters to Isolated <sup>141</sup>Ga(4Si) Sites Creates Active Centers for Propane Dehydrogenation, *Cat. Sci. Technol.* **2024**, *14*, 379–390.
92. P. Liu, A. Klyushin, C. S. Praveen, [A. Fedorov](#), W. Xie, C. Zeng, X. Huang\*, Carbon Encapsulation of Supported Metallic Iridium Nanoparticles: an *In Situ* TEM Study and Implications for Hydrogen Evolution Reaction, *ACS Nano* **2023**, *17*, 24395–24403.
91. D. F. Abbott, Y. Xu, D. A. Kuznetsov, P. Kumar, C. R. Müller\*, [A. Fedorov\\*](#), V. Mougél\*, Understanding the Synergy between Fe and Mo sites in the Nitrate Reduction Reaction on a Bio-Inspired Bimetallic MXene Electrocatalyst, *Angew. Chem. Int. Ed.* **2023**, *62*, e202313746.
90. M. Nadjafi, Y. Cui, M. Bachl, A. Oing, F. Donat, G. Luongo, P. M. Abdala, [A. Fedorov\\*](#), C. R. Müller\*, On the Importance of Benchmarking the Gas-Phase Pyrolysis Reaction in the Oxidative Dehydrogenation of Propane, *ChemCatChem*, **2023**, *15*, e202200694.
89. Z. Chen, N. K. Zimmerli, M. Zubair, A. V. Yakimov, S. Björgvinsdóttir, N. Alaniva, E. Willinger, A. B. Barnes, N. M. Bedford, C. Copéret, P. Florian\*, P. M. Abdala\*, [A. Fedorov\\*](#), C. R. Müller\*, Nature of GaO<sub>x</sub> Shells Grown on Silica by Atomic Layer Deposition, *Chem. Mater.* **2023**, *35*, 7475–7490.
88. F. Chang, [A. Fedorov\\*](#), Production of Benzene by the Hydrodemethylation of Toluene with Carbon-Supported Potassium Hydride, *ChemSusChem*, **2023**, *16*, e202202029.
87. H. Zhou, S. R. Docherty, N. Phongprueksathat, Z. Chen, A. V. Bukhtiyarov, I. P. Prosvirin, O. V. Safonova, A. Urakawa\*, C. Copéret\*, C. R. Müller\*, [A. Fedorov\\*](#), Combining Atomic Layer Deposition with Surface Organometallic Chemistry to Enhance Atomic-Scale Interactions and Improve the Activity and Selectivity of Cu–Zn/SiO<sub>2</sub> Catalysts for the Hydrogenation of CO<sub>2</sub> to Methanol, *JACS Au* **2023**, *3*, 2536–2549.
86. M. Krödel, C. Leroy, S. M. Kim, M. A. Naeem, A. Kierzkowska, Y.-H. Wu, A. Armutlulu, [A. Fedorov\\*](#), P. Florian\*, C. R. Müller\*, Of Glasses and Crystals: Mitigating the Deactivation of CaO-Based CO<sub>2</sub> Sorbents through Calcium Aluminosilicates, *JACS Au* **2023**, *3*, 3111–3126.
85. X. Huang\*, A. Beck, [A. Fedorov](#), H. Frey, B. Zhang, B. Klötzer, J. A. van Bokhoven, C. Copéret, M.-G. Willinger\*, Visualizing Structural and Chemical Transformations of an Industrial Cu/ZnO/Al<sub>2</sub>O<sub>3</sub> Pre-catalyst during Activation and CO<sub>2</sub> Reduction, *ChemCatChem*, **2022**, *14*, e202201280.
84. P. Castro Fernández, A. I. Serykh, A. V. Yakimov, I. P. Prosvirin, A. V. Bukhtiyarov, P. M. Abdala\*, C. Copéret, [A. Fedorov\\*](#), C. R. Müller\*, Atomic-Scale Changes of Silica-Supported Catalysts with Nanocrystalline or Amorphous Gallia Phases: Implications of Hydrogen Pretreatment on their Selectivity for Propane Dehydrogenation, *Cat. Sci. Technol.* **2022**, *12*, 3957–3968.
83. A. Kurlov, D. Stoian, A. Baghizadeh, E. Kountoupi, E. B. Deeva, M. Willinger, P. M. Abdala\*, [A. Fedorov\\*](#), C. R. Müller\*, The Structural Evolution of Mo<sub>2</sub>C and Mo<sub>2</sub>C/SiO<sub>2</sub> under Dry

- Reforming of Methane Conditions: Morphology and Support Effects, *Cat. Sci. Technol.* **2022**, *12*, 5620–5628.
82. Z. Chen, S. R. Docherty, P. Florian, A. Kierzkowska, I. B. Moroz, P. M. Abdala, C. Copéret\*, C. R. Müller\*, A. Fedorov\*, From Ethene to Propene (ETP) on Tailored Silica-Alumina Supports with Isolated Ni(II) Sites: Uncovering the Importance of Surface Nickel Aluminate Sites and the Carbon-Pool Mechanism, *Cat. Sci. Technol.* **2022**, *12*, 5861–5868.
  81. A. Tsoukalou, A. I. Serykh\*, E. Willinger, A. Kierzkowska, P. M. Abdala\*, A. Fedorov\*, C. R. Müller\*, Hydrogen Dissociation Sites on Indium-Based ZrO<sub>2</sub>-Supported Catalysts for Hydrogenation of CO<sub>2</sub> to Methanol, *Catal. Today*, **2022**, *387*, 38–46.
  80. F. Chang, A. Fedorov\*, Carbon-Supported Potassium Hydride for Efficient Low-Temperature Desulfurization, *Chem. Eur. J.* **2022**, *28*, e202201574.
  79. P. Castro Fernández, D. Mance, C. Liu, P. M. Abdala, E. Willinger, A. A. Rossinelli, A. I. Serykh, E. A. Pidko, C. Copéret, A. Fedorov\*, C. R. Müller\*, Bulk and Surface Transformations of Ga<sub>2</sub>O<sub>3</sub> Nanoparticle Catalysts for Propane Dehydrogenation Induced by a H<sub>2</sub> Treatment, *J. Catal.* **2022**, *408*, 155–164.
  78. A. Tsoukalou, N. S. Bushkov, S. R. Docherty, D. Mance, A. I. Serykh, P. M. Abdala, C. Copéret\*, A. Fedorov\*, C. R. Müller\*, Surface Intermediates in In-Based ZrO<sub>2</sub>-Supported Catalysts for Hydrogenation of CO<sub>2</sub> to Methanol, *J. Phys. Chem. C*, **2022**, *126*, 1793–1799.
  77. P. Castro Fernández, D. Mance, C. Liu, I. B. Moroz, P. M. Abdala, E. A. Pidko\*, C. Copéret, A. Fedorov\*, C. R. Müller\*, Propane Dehydrogenation on Ga<sub>2</sub>O<sub>3</sub>-Based Catalysts: Contrasting Performance with Coordination Environment and Acidity of Surface Sites, *ACS Catal.* **2021**, *11*, 907–924.
  76. M. Volkov\*, E. Willinger\*, D. A. Kuznetsov, C. R. Müller, A. Fedorov, P. Baum, Photo-Switchable Nanoripples in Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> MXene, *ACS Nano*, **2021**, *15*, 14071–14079.
  75. H. Fan, L. Qiu, A. Fedorov, M.-G. Willinger, F. Ding\*, X. Huang\*, Dynamic State and Active Structure of Ni-Co Catalyst in Carbon Nanofiber Growth Revealed by In Situ Transmission Electron Microscopy, *ACS Nano*, **2021**, *15*, 17895–17906.
  74. X. Huang\*, T. Jones, A. Fedorov, C. Copéret, R. Farra, R. Schlögl, M.-G. Willinger\*, Phase Coexistence and Structural Dynamics of Redox Metal Catalysts Revealed by Operando TEM, *Adv. Mater.* **2021**, *33*, 2101772.
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  72. P. Castro Fernández, M. Kaushik, Z. Wang, D. Mance, E. Kountoupi, E. Willinger, P. M. Abdala, C. Copéret, A. Lesage\*, A. Fedorov\*, C. R. Müller\*, Uncovering Selective and Active Ga Surface Sites in Gallia-Alumina Mixed-Oxide Propane Dehydrogenation Catalysts by Dynamic Nuclear Polarization Surface Enhanced NMR Spectroscopy, *Chem. Sci.*, **2021**, *12*, 15273–15283.
  71. D. A. Kuznetsov, Z. Chen, P. M. Abdala, O. V. Safonova, A. Fedorov\*, C. R. Müller\*, Single-Atom-Substituted Mo<sub>2</sub>CT<sub>x</sub>:Fe-Layered Carbide for Selective Oxygen Reduction to Hydrogen Peroxide: Tracking the Evolution of the MXene Phase, *J. Am. Chem. Soc.* **2021**, *143*, 5771–5778.
  70. Y.-H. Wu, D. A. Kuznetsov\*, N. C. Pflug, A. Fedorov, C. R. Müller\*, Solar-Driven Valorisation of Glycerol on BiVO<sub>4</sub> Photoanodes: Effect of Co-Catalyst and Reaction Media on Reaction Selectivity, *J. Mater. Chem. A*, **2021**, *9*, 6252–6260.

69. M. Nadjafi, A. M. Kierzkowska, A. Armutlulu, R. Verel, A. Fedorov, P. M. Abdala\*, C. R. Müller\*, Correlating the Structural Evolution of ZnO/Al<sub>2</sub>O<sub>3</sub> to Spinel Zinc Aluminate with its Catalytic Performance in Propane Dehydrogenation, *J. Phys. Chem. C*, **2021**, *125*, 14065–14074.
68. H. Zhou, Z. Chen, E. D. López, E. Lam, A. Tsoukalou, E. Willinger, D. A. Kuznetsov, D. Mance, A. Kierzkowska, F. Donat, P. M. Abdala, A. Comas-Vives\*, C. Copéret\*, A. Fedorov\*, C. R. Müller\*, Engineering the Cu/Mo<sub>2</sub>CT<sub>x</sub> (MXene) Interface to Drive the Rate of CO<sub>2</sub> Hydrogenation to Methanol, *Nat. Catal.* **2021**, *4*, 860–871.
67. H. Zhou, Z. Chen, E. Kountoupi, A. Tsoukalou, P. M. Abdala, P. Florian, A. Fedorov\*, C. R. Müller\*, Two-Dimensional Molybdenum Carbide 2D-Mo<sub>2</sub>C as a Superior Catalyst for CO<sub>2</sub> Hydrogenation, *Nat. Commun.* **2021**, *12*, 5510.
66. M. A. Naeem, P. M. Abdala\*, A. Armutlulu, S. M. Kim, A. Fedorov, C. R. Müller\*, Exsolution of Metallic Ru Nanoparticles from Defective, Fluorite-type Solid Solutions Sm<sub>2</sub>Ru<sub>x</sub>Ce<sub>2-x</sub>O<sub>7</sub> to Impart Stability on Dry Reforming Catalysts, *ACS Catal.* **2020**, *10*, 1923–1937.
65. M. Nadjafi, P. M. Abdala, R. Verel, D. Hosseini, O. V. Safonova, A. Fedorov\*, C. R. Müller\*, Reducibility and Dispersion Influence the Activity in Silica-Supported Vanadium-Based Catalysts for the Oxidative Dehydrogenation of Propane: The Case of Sodium Decavanadate, *ACS Catal.* **2020**, *10*, 2314–2321.
64. A. Tsoukalou, P. M. Abdala\*, A. Armutlulu, E. Willinger, A. Fedorov\*, C. R. Müller\*, *Operando* X-Ray Absorption Spectroscopy Identifies Monoclinic ZrO<sub>2</sub>:In Solid Solution as the Active Phase for the Hydrogenation of CO<sub>2</sub> to Methanol, *ACS Catal.* **2020**, *10*, 10060–10067.
63. A. Svyatova, E. S. Kononenko, K. V. Kovtunov\*, D. Lebedev, E. Yu. Gerasimov, A. V. Bukhtiyarov, I. P. Prosvirin, V. I. Bukhtiyarov, C. R. Müller, A. Fedorov\*, I. V. Koptug, Spatially Resolved NMR Spectroscopy of Heterogeneous Gas Phase Hydrogenation of 1,3-Butadiene with Parahydrogen, *Catal. Sci. Technol.* **2020**, *10*, 99–104.
62. M. Nadjafi, A. M. Kierzkowska, P. M. Abdala, R. Verel, O. V. Safonova, A. Fedorov\*, C. R. Müller\*, Oxidative Dehydrogenation of Propane on Silica-Supported Vanadyl Sites Promoted with Sodium Metavanadate, *Catal. Sci. Technol.* **2020**, *10*, 7186–7193.
61. J. J. Silva, M. A. B. Ferreira, A. Fedorov\*, M. S. Sigman\*, C. Copéret\*, Molecular-Level Insight in Supported Olefin Metathesis Catalysts by Combining Surface Organometallic Chemistry, High Throughput Experimentation, and Data Analysis, *Chem. Sci.* **2020**, *11*, 6717–6723.
60. P. S. Engl, A. Tsygankov, J. J. Silva, J.-P. Lange, C. Copéret, A. Togni, A. Fedorov\*, Acrylate Esters by Ethenolysis of Maleate Esters with Ru Metathesis Catalysts: an HTE and a Technoeconomic Study, *Helv. Chim. Acta*, **2020**, *103*, e2000035.
59. D. A. Kuznetsov, M. A. Naeem, P. V. Kumar, P. M. Abdala, A. Fedorov\*, C. R. Müller\*, Tailoring Lattice Oxygen Binding in Ruthenium Pyrochlores to Enhance Oxygen Evolution Activity, *J. Am. Chem. Soc.* **2020**, *142*, 7883–7888.
58. P. Castro Fernández, M. V. Blanco, R. Verel, E. Willinger, A. Fedorov, P. M. Abdala\*, C. R. Müller\*, Atomic-Scale Insight into the Structure of Metastable  $\gamma$ -Ga<sub>2</sub>O<sub>3</sub> Nanocrystals and their Thermally-Driven Transformation to  $\beta$ -Ga<sub>2</sub>O<sub>3</sub>, *J. Phys. Chem. C*, **2020**, *124*, 20578–20588.
57. M. A. Naeem, D. B. Burueva, P. M. Abdala, N. S. Bushkov, D. Stoian, A. V. Bukhtiyarov, I. P. Prosvirin, V. I. Bukhtiyarov, K. V. Kovtunov, I. V. Koptug, A. Fedorov\*, C. R. Müller\*, Deciphering the Nature of Ru Sites in Reductively-Exsolved Oxides with Electronic and Geometric Metal-Support Interactions, *J. Phys. Chem. C*, **2020**, *124*, 25299–25307.

56. A. Kurlov, X. Huang\*, E. B. Deeva, P. M. Abdala, A. Fedorov\*, C. R. Müller\*, Molybdenum Carbide and Oxycarbide from Carbon-Supported MoO<sub>3</sub> Nanosheets: Phase Evolution and DRM Catalytic Activity Assessed by TEM and *in situ* XANES/XRD Methods, *Nanoscale*, **2020**, *12*, 13086–13094.
55. M. Rekhina, A. Dal Pozzo, D. Stoian, A. Armutlulu, F. Donat, M. V. Blanco, Z.-J. Wang, M.-G. Willinger, A. Fedorov, P. M. Abdala\*, C. R. Müller\*, Effect of Molten Sodium Nitrate on the Decomposition Pathways of Hydrated Magnesium Hydroxycarbonate to Magnesium Oxide Probed by *in situ* Total Scattering, *Nanoscale*, **2020**, *12*, 16462–16473.
54. A Kurlov, E. B. Deeva, P. M. Abdala, D. Lebedev, A. Tsoukalou, A. Comas-Vives\*, A. Fedorov\*, C. R. Müller\*, Exploiting two-dimensional morphology of molybdenum oxycarbide to enable efficient catalytic dry reforming of methane, *Nat. Commun.* **2020**, *11*, 4920.
53. I. B. Moroz, A. Lund, M. Kaushik, L. Severy, D. Gajan, A. Fedorov\*, A. Lesage, C. Copéret\*, Specific Localization of Aluminum Sites Favors Ethene-to-Propene Conversion on (Al)MCM-41-Supported Ni(II) Single Sites, *ACS Catal.* **2019**, *9*, 7476–7485.
52. X. Huang\*, D. Teschner, M. Dimitrakopoulou, A. Fedorov, B. Frank, R. Kraehnert, F. Rosowski, H. Kaiser, S. Schunk, C. Kuretschka, R. Schlögl, M.-G. Willinger\*, A. Trunschke\*, Atomic-Scale Observation of the Metal–Promoter Interaction in Rh-Based Syngas-Upgrading Catalysts, *Angew. Chem. Int. Ed.* **2019**, *58*, 8709–8713.
51. K. V. Kovtunov\*, D. Lebedev, A. Svyatova, E. V. Pokochueva, I. P. Prosvirin, E. Y. Gerasimov, V. I. Bukhtiyarov, C. R. Müller, A. Fedorov, I. V. Koptug, Robust *In situ* Magnetic Resonance Imaging of Heterogeneous Catalytic Hydrogenation with and without Hyperpolarization, *ChemCatChem* **2019**, *11*, 969–973.
50. E. B. Deeva, A. Kurlov, P. M. Abdala, D. Lebedev, S. M. Kim, C. P. Gordon, A. Tsoukalou, A. Fedorov\*, C. R. Müller\*, *In situ* XANES/XRD Study of the Structural Stability of Two-Dimensional Molybdenum Carbide Mo<sub>2</sub>CT<sub>x</sub>: Implications for the Catalytic Activity in the Water-Gas Shift Reaction, *Chem. Mater.* **2019**, *31*, 4505–4513.
49. P. Jurt, O. G. Salnikov, T. L. Gianetti\*, N. V. Chukanov, M. G. Baker, G. Le Corre, J. E. Borger, R. Verel, S. Gauthier, O. Fuhr, K. V. Kovtunov, A. Fedorov, D. Fenske, I. V. Koptug, H. Grützmacher\*, Low-Valent Homobimetallic Rh Complexes: Influence of Ligands on the Structure and the Intramolecular Reactivity of Rh–H Intermediates, *Chem. Sci.* **2019**, *10*, 7937–7945.
48. A. Tsoukalou, P. M Abdala\*, D. Stoian, X. Huang, M.-G. Willinger, A. Fedorov\*, C. R. Müller\*, The Structural Evolution and Dynamics of an In<sub>2</sub>O<sub>3</sub> Catalyst for CO<sub>2</sub> Hydrogenation to Methanol: an *Operando* XAS-XRD and *in situ* TEM Study, *J. Am. Chem. Soc.* **2019**, *141*, 13497–13505.
47. M. A. B. Ferreira\*, J. J. Silva, S. Grosslight, A. Fedorov\*, M. S. Sigman\*, C. Copéret\*, Non-Covalent Interactions Drive the Efficiency of Molybdenum Imido Alkylidene Catalysts for Olefin Metathesis, *J. Am. Chem. Soc.* **2019**, *141*, 10788–10800.
46. D. A. Kuznetsov, Z. Chen, P. V. Kumar, A. Tsoukalou, A. Kierzkowska, P. M. Abdala, O. V. Safonova, A. Fedorov\*, C. R. Müller\*, Single Site Cobalt Substitution in 2D Molybdenum Carbide (MXene) Enhances Catalytic Activity in the Hydrogen Evolution Reaction, *J. Am. Chem. Soc.* **2019**, *141*, 17809–17816.
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44. C. Mondelli\*, [A. Fedorov\\*](#), Conference Report SCS Seminar 2018/1: Catalysis Across Scales, *Chimia* **2018**, 72, 822–823.
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38. E. Oakton, D. Lebedev, M. Povia, D. F. Abbott, E. Fabbri, [A. Fedorov](#), M. Nachtegaal, C. Copéret\*, T. J. Schmidt\*,  $\text{IrO}_2\text{-TiO}_2$ : a High-Surface Area, Active and Stable Electrocatalyst for the Oxygen Evolution Reaction, *ACS Catal.* **2017**, 7, 2346–2352.
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